Rauhfrost, Haarfrost, Nebelreif, Duft, Duftanhang, Anhang, Abhang, Bihang, Anreim, Anraum. In Austria, southern Germany, and Thuringia the most common expression is the ancient one "Duft" (see above, p. 385), but the name "Anhang" is also ancient and is widely used in forest districts (Forstkreisen). (*See* Grimm, "Deutsch. Wörterbuch," v. 1, p. 366, "rîfe und anehanc"). To-day the most usual term in northern Germany and also among meteorologists is "Rauhreif." In the Riesengebirge the phenomenon is called "Anraum," probably derived from "Anreim," which is the more usual form of the word in Austria. This word goes back to the Old Norse "hrim," whence are also derived the English "rime" and the French "frimas."[31]

(*To be continued.*)

ON THE VARIABILITY OF TEMPERATURE.[1]

By ALFRED ANGOT, Director.

[Dated: Bureau Central Météorologique de France.]

The meteorological character of a given day depends, in some degree, upon that of the preceding day and perhaps even upon that of several previous days.[2] The question thus arises whether it is possible to go further and to forecast, e. g., the character of a season from that of the preceding season, or to say if after a series of warm winters the chances of a severe winter are increased. A very large number of similar questions can be raised. Temperatures may be used as a numerical example of the answers to such questions.

The arithmetical mean of the temperatures of the same month for a large number of consecutive years is called the "normal" temperature of that month. The normal temperature for December at Paris is 2.7°C. The temperature of a particular December, for instance, December, 1914, was 6.2°C. The departure of this temperature from the normal December temperature +3.5°C., that is the difference between 6.2° and 2.7°. If all these departures were the result of purely fortuitous causes, the theory of probability would give directly the degree of probability of a departure of a given amount. Thus it will be found that the departure of which the probability is one-half, i. e., the "probable departure," is 1.9°C. In 100 Decembers there would be 50 with a temperature between 0.8° (2.7°−1.9°) and 4.6°C. (2.7°+1.9°). Likewise there would be 18 in which the departure from the normal would exceed twice the probable departure—that is, of which the temperature would be above 6.5° or below −1.1° C. The probability of other departures may likewise be computed.

In a study of the temperatures of France [3] published 16 years ago, observations made during 50 years in 22 different sections of France and neighboring countries were discussed from this point of view. In all these studies without exception the results rigorously conformed to those obtained from the theory of probabilities. The physical causes that determine one month shall be warm or cold are so many and so complex that the net result is the same as that from purely fortuitous causes.

It is possible to go a step further and inquire if these causes have a certain permanence and continue to act in the same sense during a considerable time, two months, a season, or a longer period; in other words, if the character of the beginning of a season justifies a forecast for the entire season, or that of one season a forecast for a later season. If the character of a month (warm or cold) is represented by *A* and the opposite character by *B*, two consecutive months offer the combinations *AA* and *AB*. Likewise for three consecutive months there will be the combinations *AAA*, *AAB*, *ABA*, *ABB*. If there is a relation between the character of one month and that of the following month one of these combinations will appear more frequently than the others.

Observations of temperature made in the vicinity of Paris during the 65 years, 1851 to 1915, have been examined to determine whether such a condition exists. As an example the results for some groups of three consecutive months are given below; the figures indicate the number of occurrences of the different combinations:

	AAA	*AAB*	*ABA*	*ABB*
October-November-December	18	12	19	16
November-December-January	17	17	15	16
December-January-February	18	14	19	14
June-July-August	22	18	12	13

Even for two consecutive months there is no systematic relation. The different combinations have all the same probability as that which appears in the succession of red and black on the roulette wheel.

This is shown even more strongly when successions of longer durations are examined. No relation can be made out between the temperature of one month and that of the following month, still less between the temperature of a season and that of the following season; a warm summer will be succeeded indifferently by a warm winter or by a cold winter.

Forecasts made from the actions of animals or plants are in the same category. There is a belief that when the beech trees lose their leaves earlier than usual an exceptionally early or severe winter will follow. The causes that bring about the fall of leaves from a tree are to be found in the meteorological characteristics of the summer or autumn. It has just been shown that these characteristics have no influence on those of the following season.

Another prejudice not less frequent supposes that the meteorological phenomena tend to be complementary within short periods. From 1909 to 1914 the six consecutive Decembers were all warm. Therefore, if the short-period compensation were effective, the chances that the following December, that of 1915, will be cold would be increased. But this is not the case; past seasons do not control future conditions. After a series of very warm months the chances that the following month will be warm or cold remain equal, which is the same as the chance that red or black will appear at roulette after a run of any kind whatever.

In conclusion, the variability of monthly, seasonal, or annual temperatures in France follows exactly the same law as if the causes were purely fortuitous, and it is not possible to forecast for months, seasons, or years by means of past phenomena.

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[31] The name "silver thaw," devised by English meteorologists for the phenomenon of rime (Rauhreif), seems to be unable to maintain its footing even in professional circles. Earlier good observers like Luke Howard, Scoresby, and others, always used the word "rime" for this deposit. At present there is great confusion in this matter, for Mossman has applied the name "silver thaw" to the deposit known as "glazed frost" (Engl.), "glaze" (U. S. A.), (Glatteis).

Old French textbooks in meteorology applied the term "frimas" to hoarfrost (Reif) and to rime (Rauhreif). Only within the last 50 years has there been a clear discrimination between "gelée blanche" and "givre" [i. e., between hoarfrost and rime]; while "frimas" has disappeared from the scientific literature.—*Author.*

Translator's note.—The usage in the United States with regard to these terms has been discussed in some detail in the MONTHLY WEATHER REVIEW, May, 1916, 44: 281-286, notably p. 285-6, where the U. S. Weather Bureau officially adopts "Rime" (Rauhreif) and "Glaze" (Glatteis).

The same article also shows to what extent the term "silver thaw" is known and used in the United States and Canada.—C. A., jr.

[1] *Angot, [Charles] A[lfred].* Sur la variabilité des temperatures. Comptes rendus, Acad. agric. de France, Paris, déc. 22, 1915, 1:789-792. *Transl.* by W. G. Reed.

[2] In this connection see: *Newham, E. V.* The persistence of wet and dry weather. Quart. jour., Roy. meteorol. soc., London, July, 1916, 42:153-162. Abstracted on p. 393 of this issue of the REVIEW.

[3] *Angot, A.* Études sur le climat de la France: Temperature, 1ère. Partie—Stations de comparison. Annales, Bur. cent. météorol. de France, 1897, I. Mémoires, Paris, 1899, pp. B93-B170; *ibid.*, 1900, I. Mémoires, Paris, 1902, pp. B33-B118.